An Eclipse Based Software Solution for Space Mission Design

EclipseCon Europe 2011 – Philipp M. Fischer

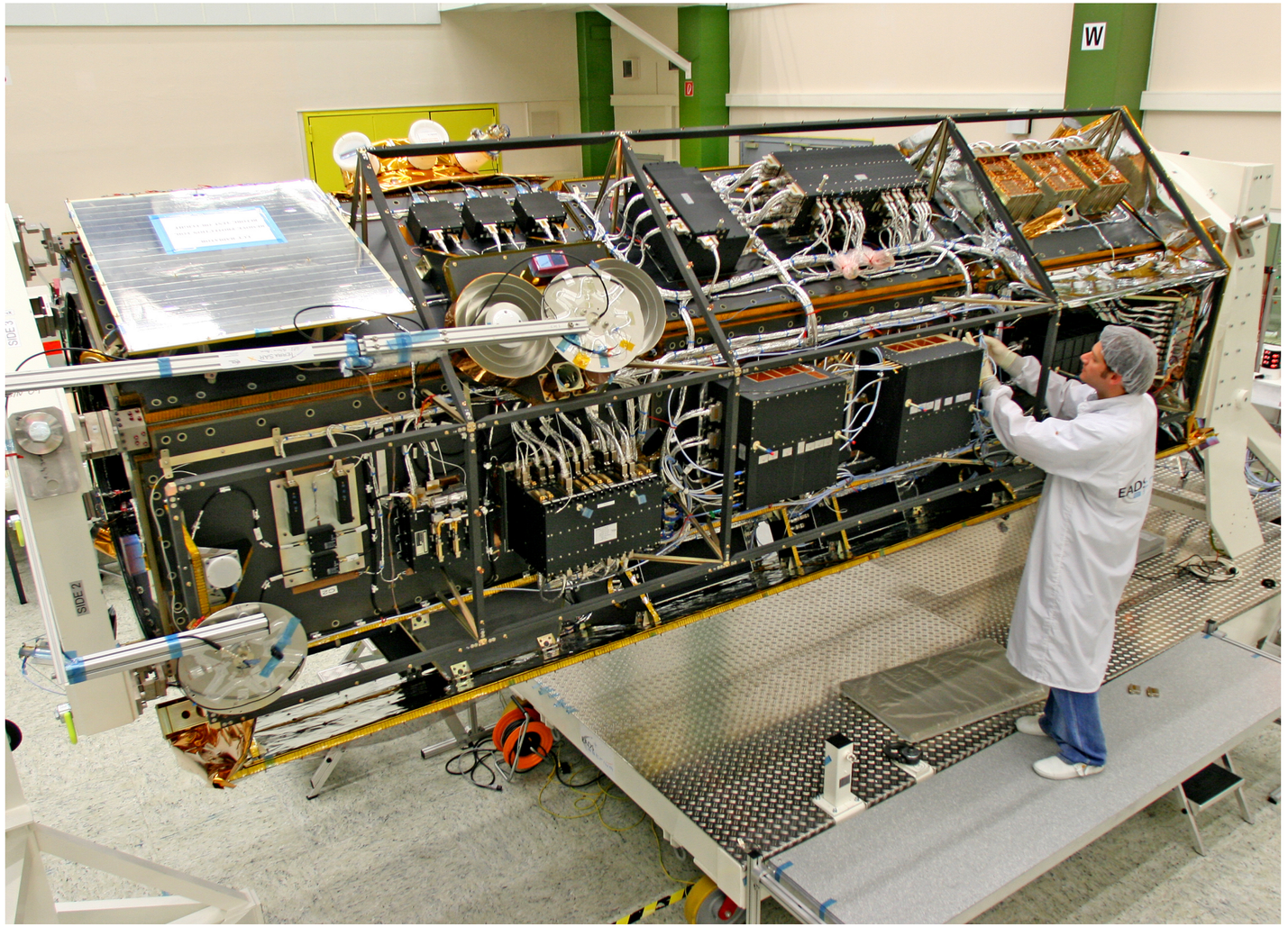
Today‘s Mission…

- A story about building spacecrafts…
- Building spacecrafts using Eclipse…
- A data model for spacecraft design…
- The good and the bad using Eclipse…

*Source : www.media.dlr.de (accessed 31.10.2011)

Building a Spacecraft is Complex…

- Knowledge of various experts
  - Power
  - Structure
  - Thermal
  - Propulsions
- Long term projects
  - Space shuttle
  - Mars rovers
  - ISS



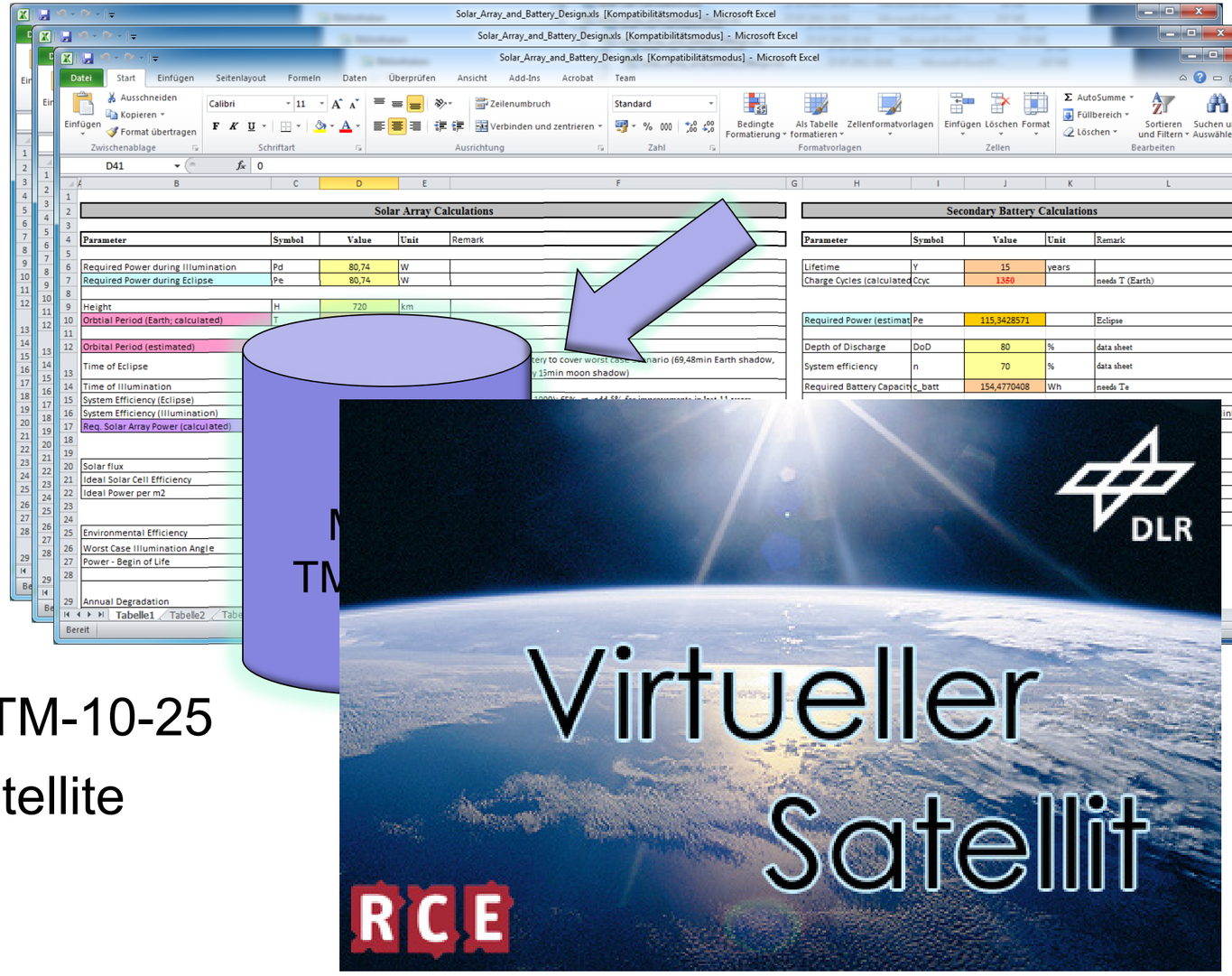
*Source : www.media.dlr.de (accessed 31.10.2011)

Working in Parallel – The CEF

- Built in 2008 in Bremen
- Bringing the experts together
  - Estimating…
    - Weight
    - Power
    - Costs
- Roughly 14 days
  - 2 Sessions per day
  - Feasible results: +/- 15%

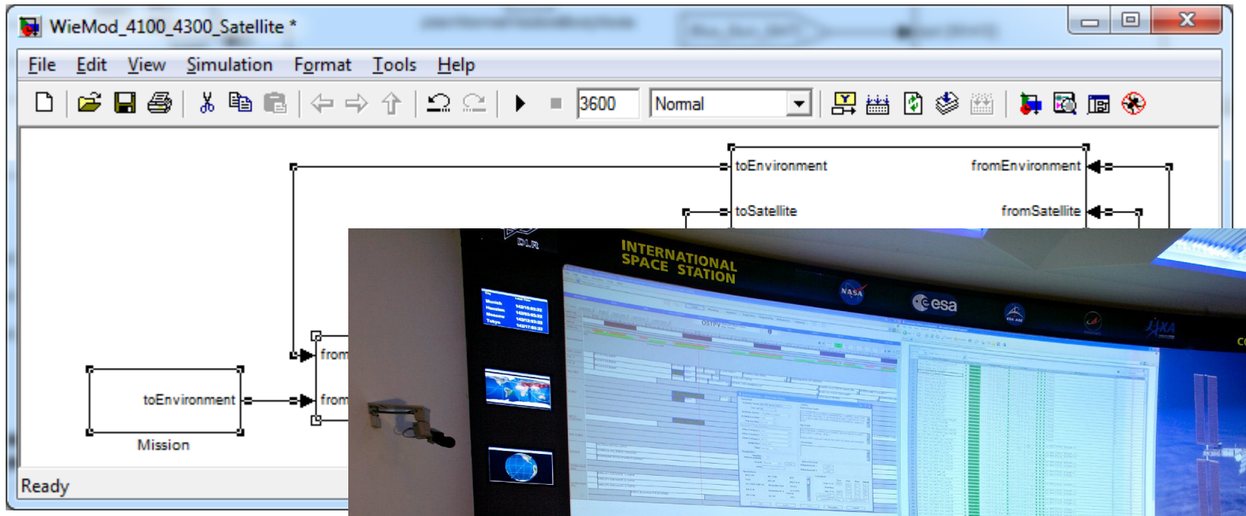
From Excel Sheets to Model Driven…

- Data provided as parameters
- The old way…
  - Modeled in Excel
  - Done by DLR, ESA, NASA
- The new way…
  - Modeled in Step – ECSS-E-TM-10-25
  - Modeled in EMF – Virtual Satellite



A Model Beyond the Early Design…

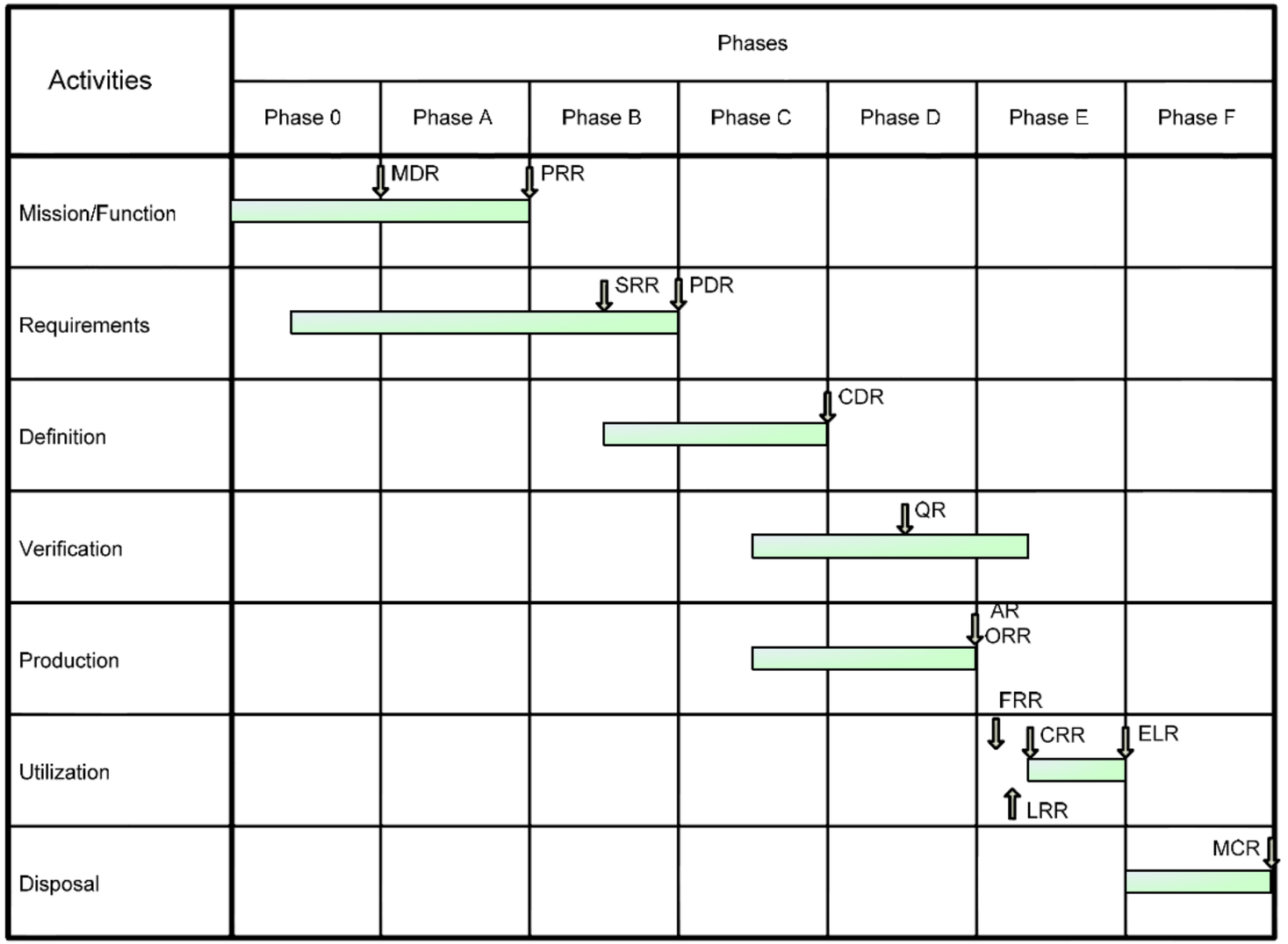
- It is not just parameters
  - Simulations
  - CAD
  - Commands



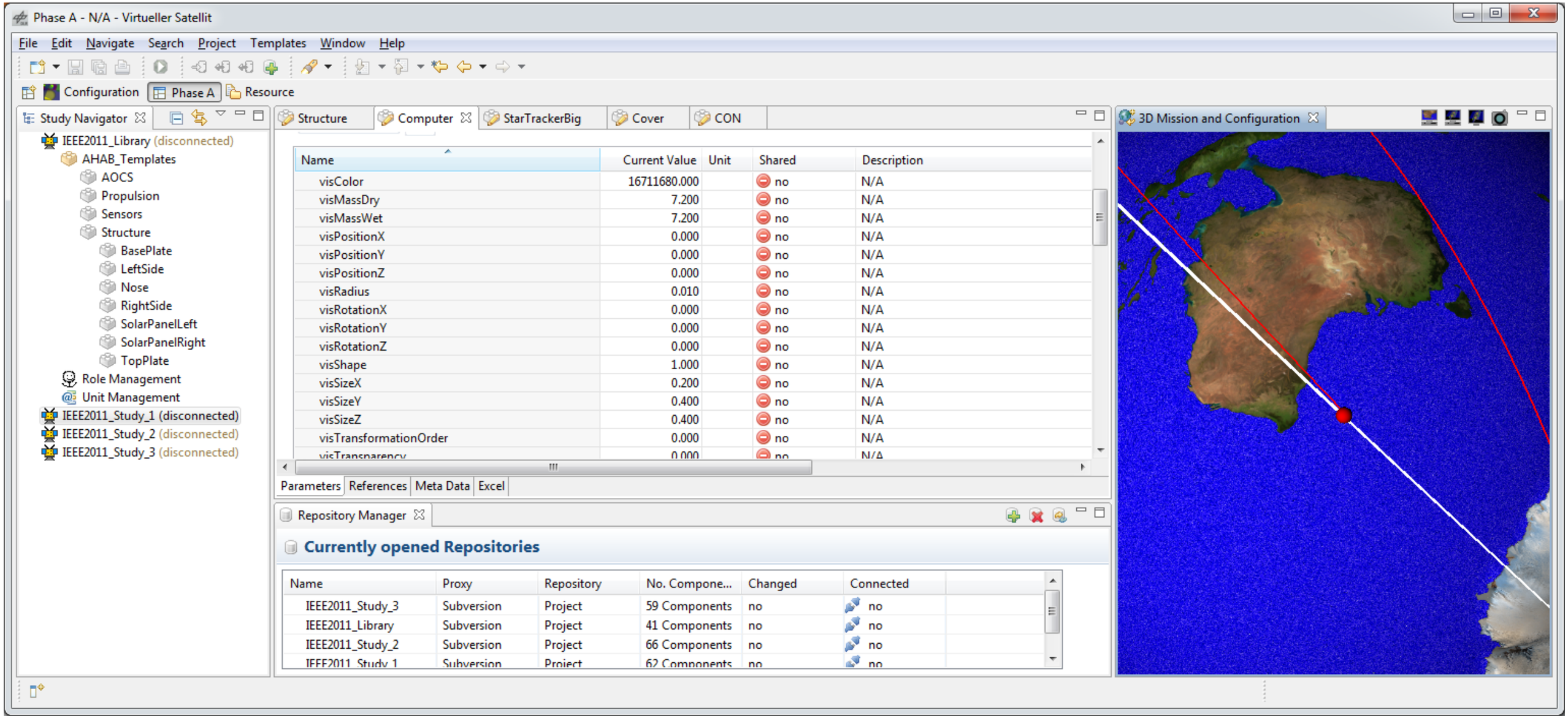
- Vision: Supporting the whole lifecycle
  - ECSS-TM-10-23 VSD
  - DLR Virtual Satellite

Virtual Satellite an Aerospace Design Tool

- Developed together with CEF
- Tool for spacecraft lifecycle
  - Phase A/B - Planning
  - Phase C/D - Building
  - Phase E/F - Operating
- Development in progress
  - Phase A/B in progress
  - Phase B/C just started



*Source : **ECSS-M-ST-10C Rev. 1 ESA-ESTEC Standards Devision**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Configuration Phase A Resource
Study Navigator
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AOCS
Propulsion
Sensors
Structure
BasePlate
LeftSide
Nose
RightSide
SolarPanelLeft
SolarPanelRight
TopPlate
Role Management
Unit Management
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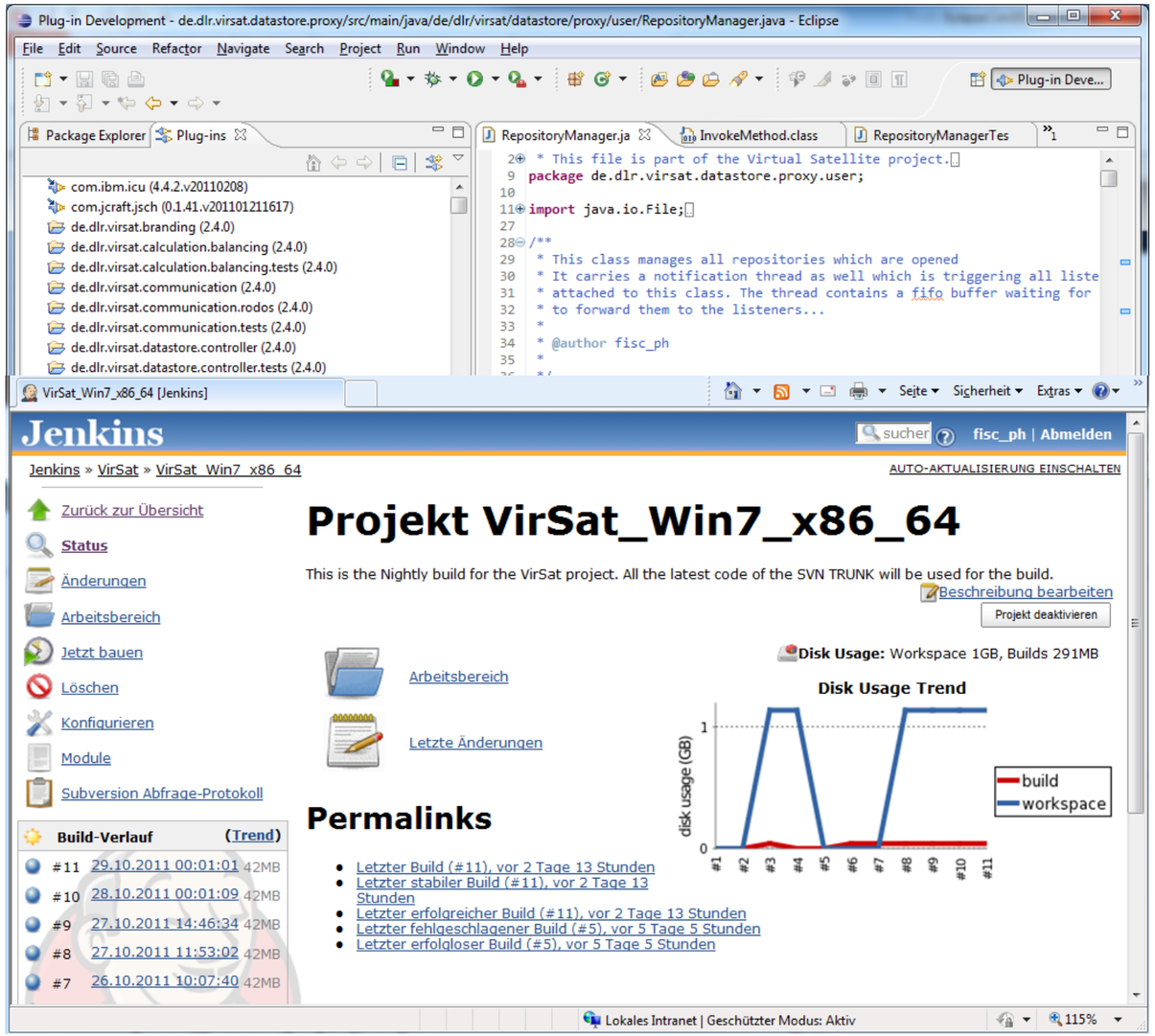
Name Proxy Repository No. Compone... Changed Connected
IEEE2011_Study_3 Subversion Project 59 Components no no
IEEE2011_Library Subversion Project 41 Components no no
IEEE2011_Study_2 Subversion Project 66 Components no no
3D Mission and Configuration

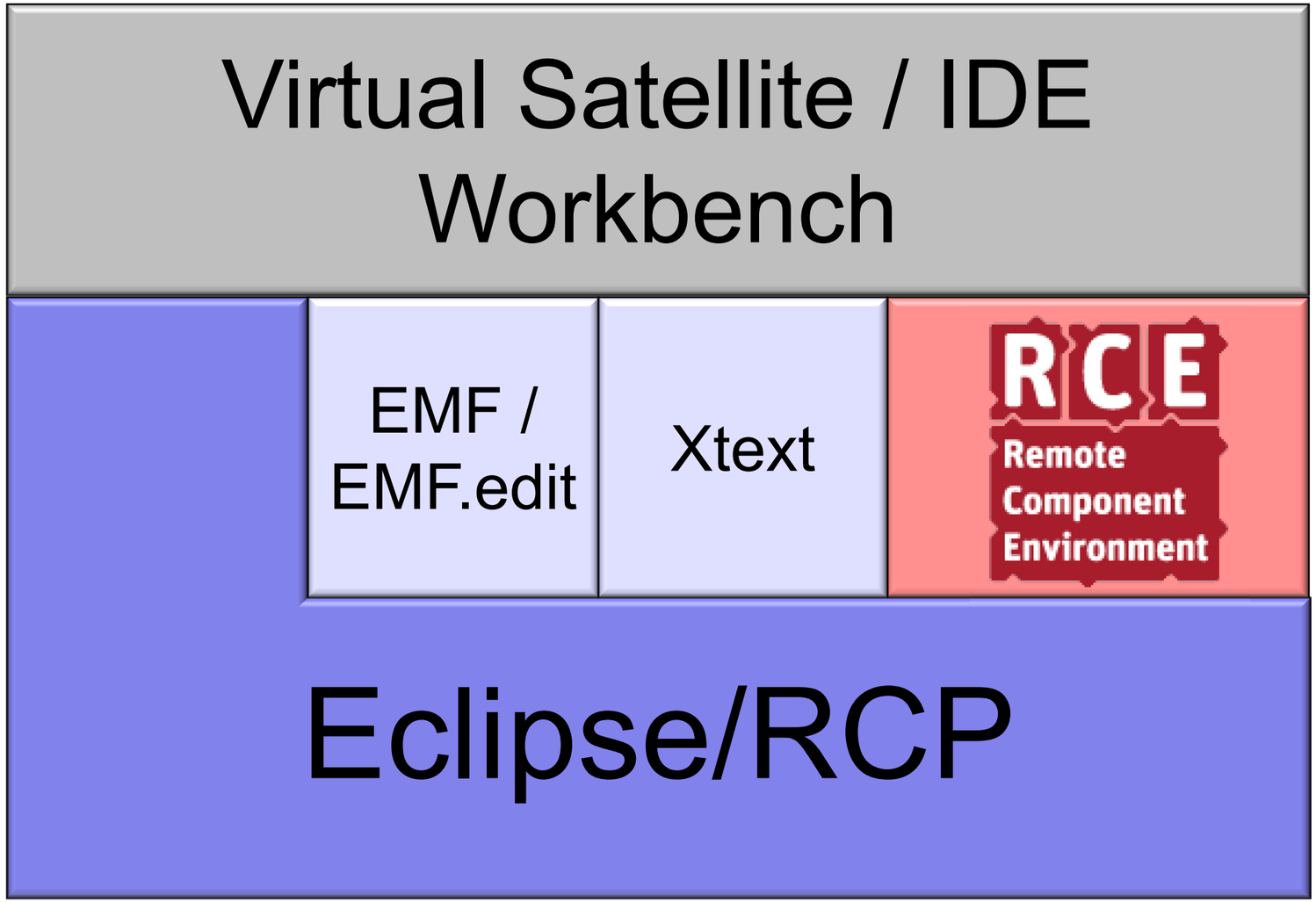
And How it is Made…

- A productive software – not just science
  - 2 Engineers full-time
  - 1 Student part-time
- Agile project – DLR Software Process
- Quality procedures
  - Junit and Jubula
- Build Process – Continuous Integration
  - SVN, RepoGuard, Maven, Mantis, Jenkins …



Virtual Satellite‘s Architecture

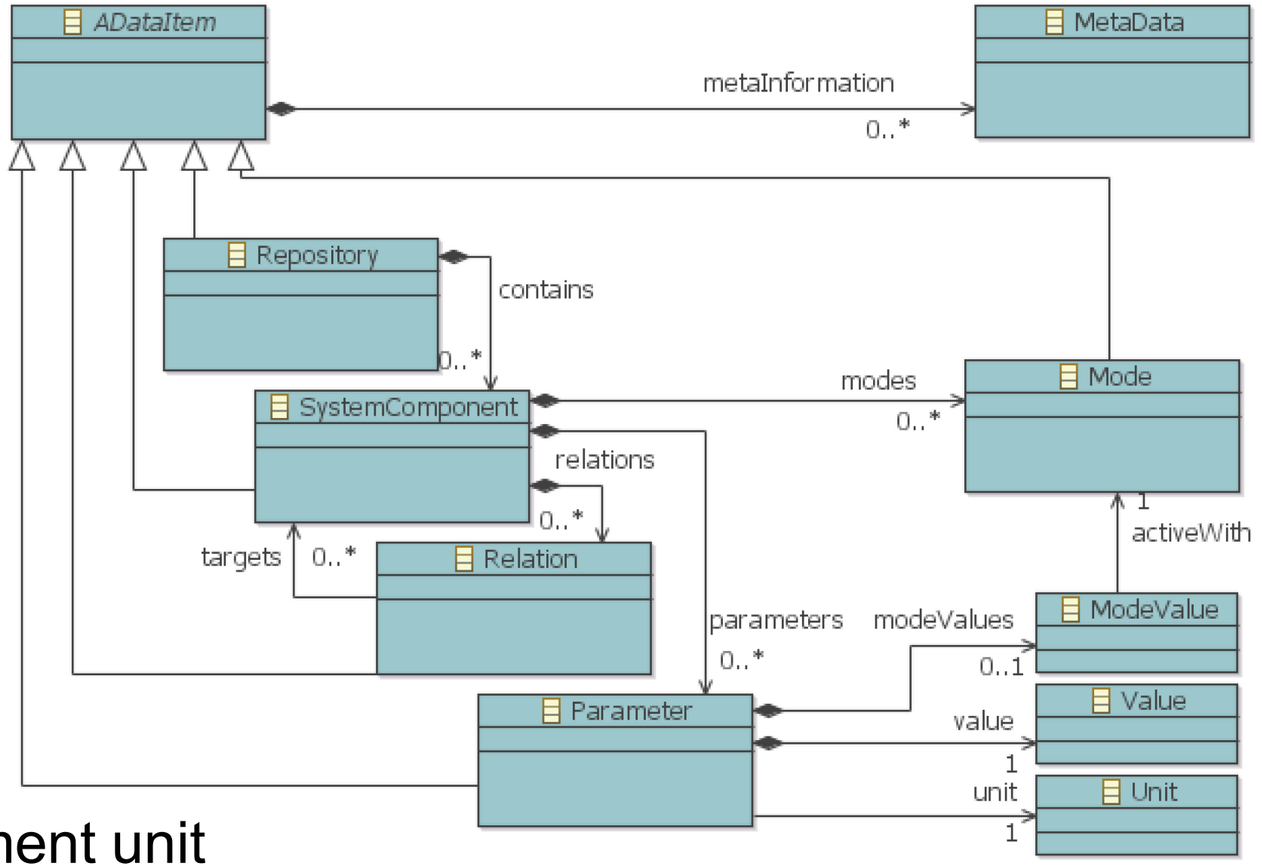
- Eclipse widely spread in
  - Academia
  - Industry
- Build on Eclipse RCP using
  - DLR-RCE
  - EMF
  - EMF.edit
  - Xtext



*Source : sourceforge.net/projects/rcenvironment/ (accessed 31.10.2011)

One Data Model for All

- One central data model
  - Common place of knowledge
- Modeling
  - Decomposition of spacecraft
  - Parameters for phase A/B
  - Calculations
  - QUDV
- Repository as central data management unit
  - Backend Interchangeable

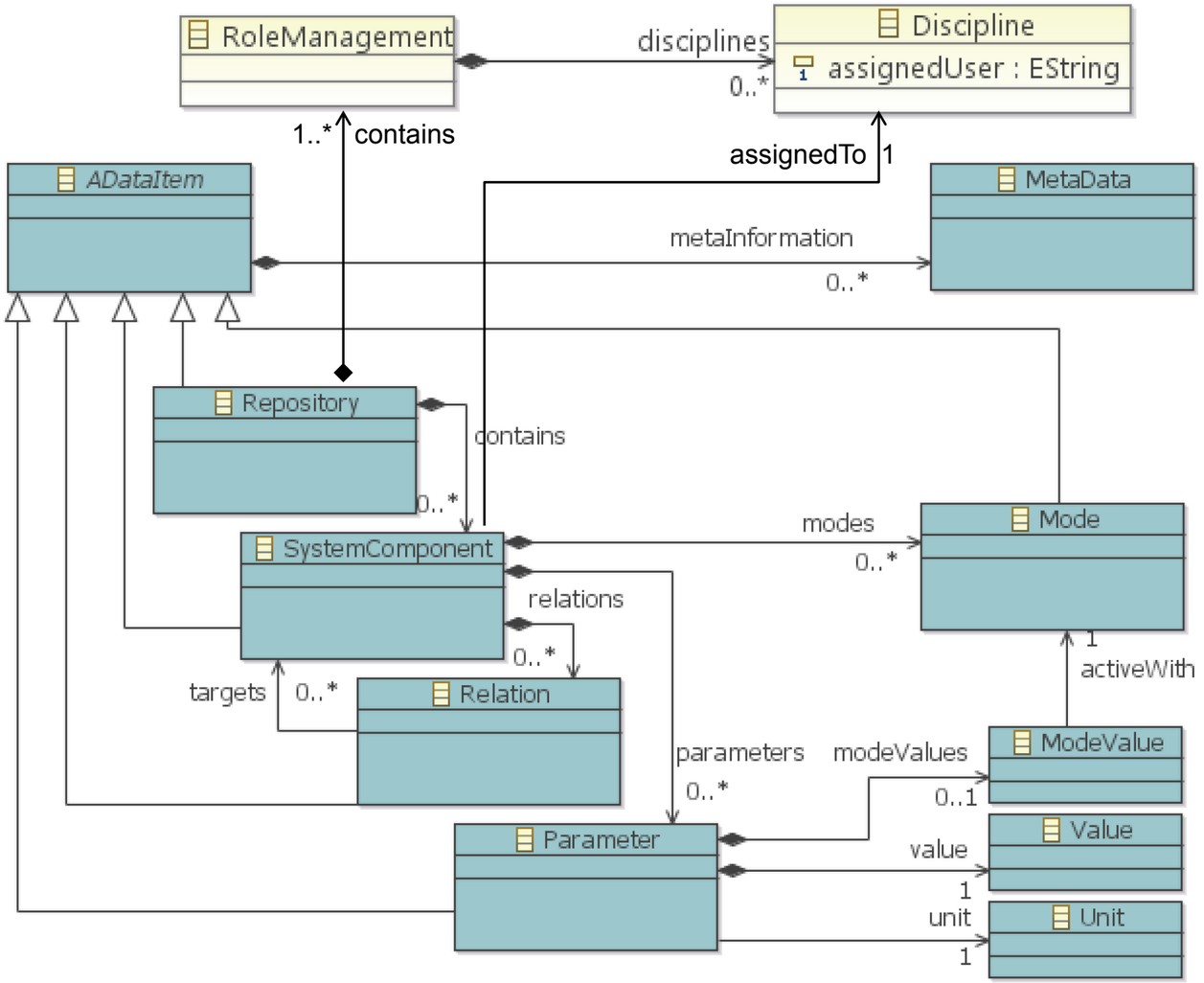


How to Get it Distributed?

- One data model
  - But multiple engineers
- Engineers used to SVN
  - Commit – Provide changes
  - Update – Obey changes
- Organizing read and write
- Avoiding merge conflicts

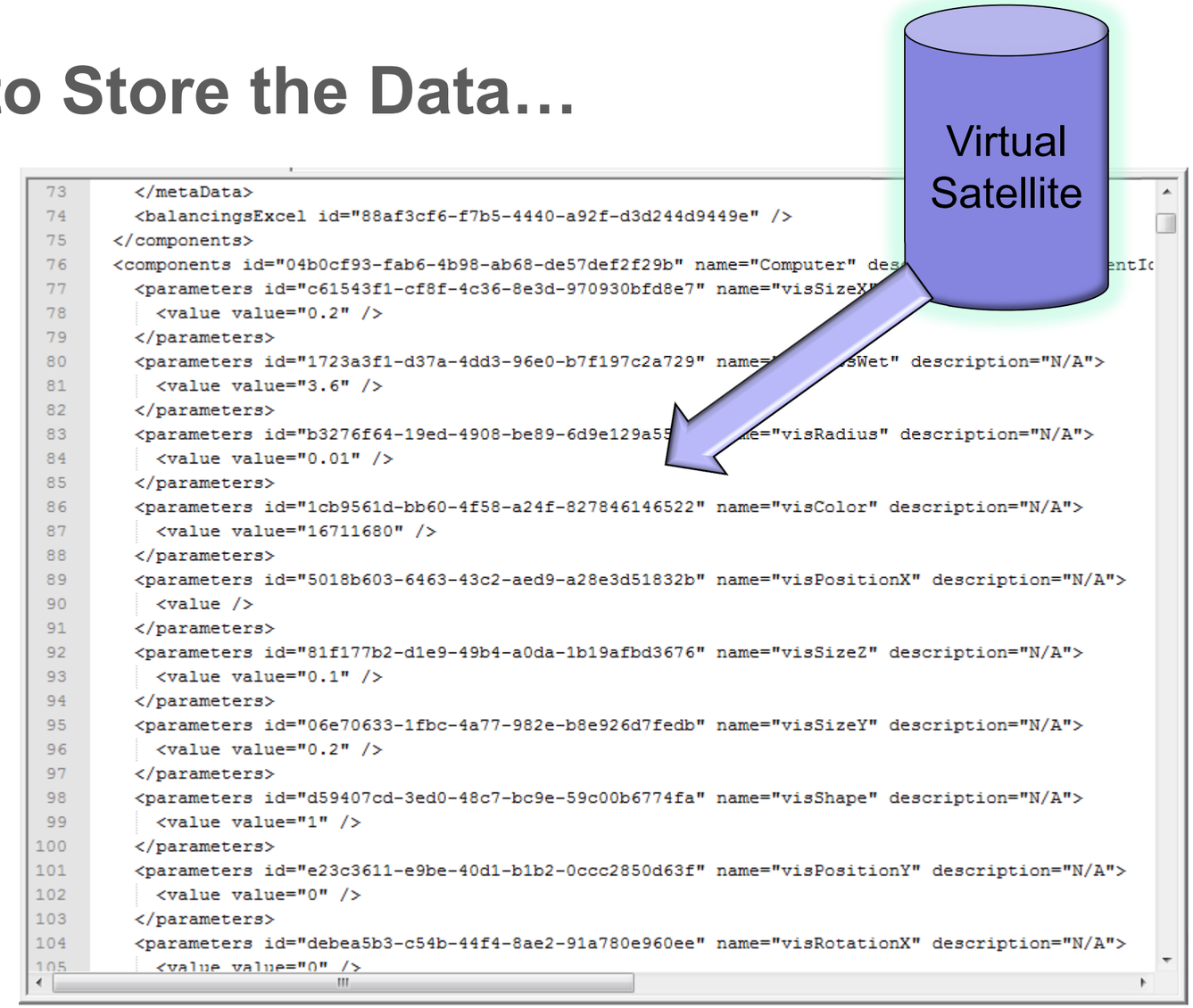
First Step – Who is Allowed to Modify the Data?

- Modeling Users
  - A Discipline
  - One User Name
- System Component
  - Applying one User
  - Sharing data areas
- Asking RCE LDAP for authorization
  - Granting permissions



Second Step – Serialization to Store the Data…

- Text for SVN Backend
  - Small changes in one session
- Using XMI
  - Provided by EMF
- So far writing as one resource
  - Multiple resources intended

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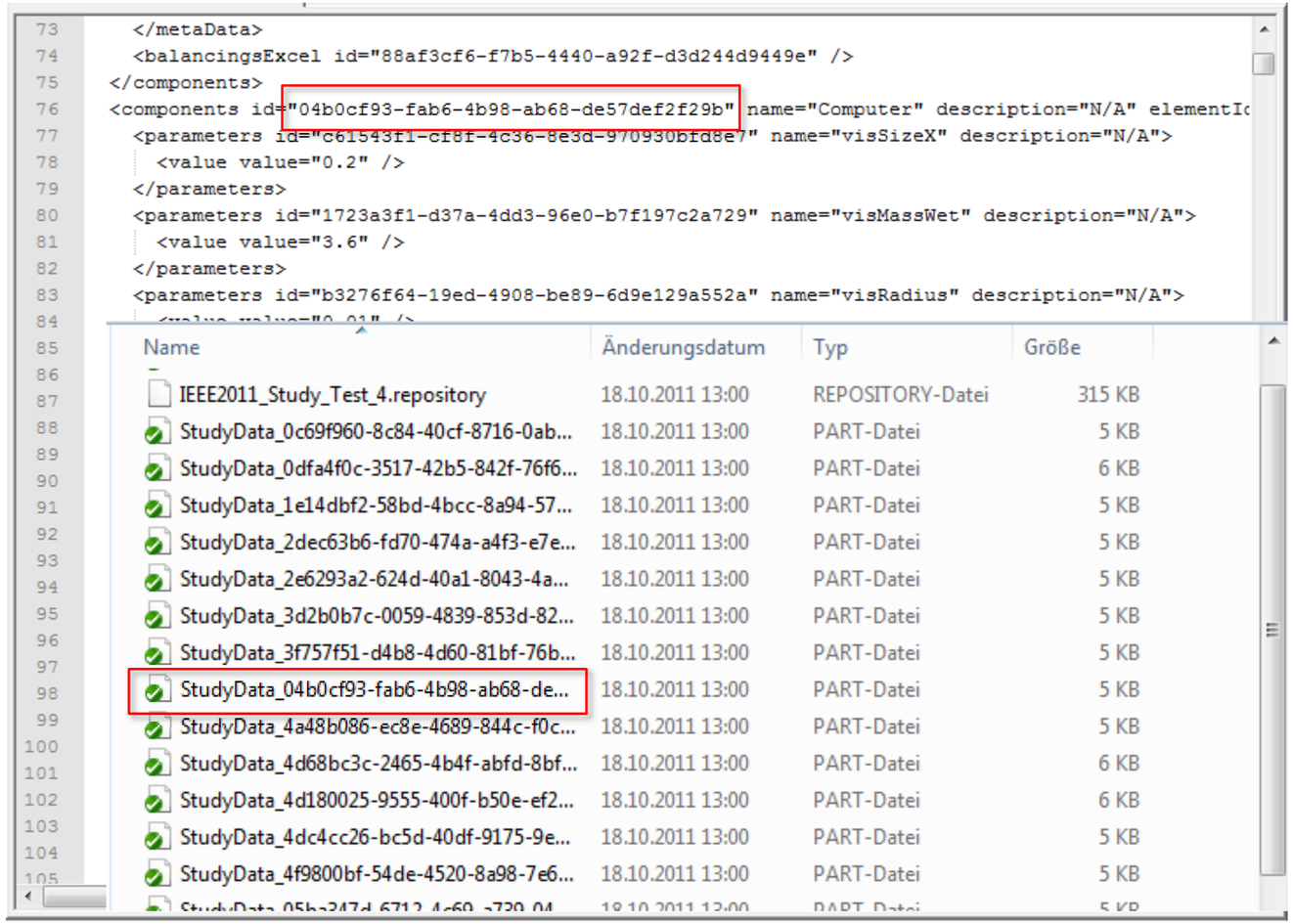
```

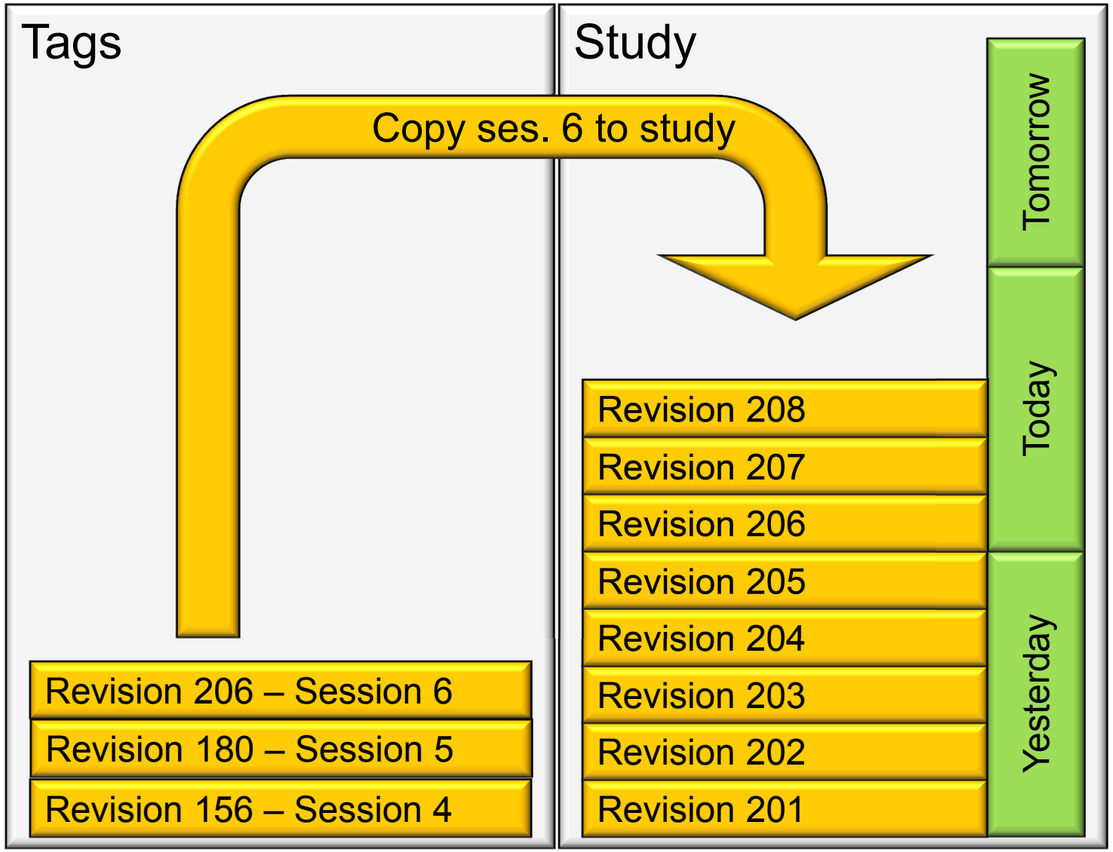
Third Step – Separation for Mutual Units…

- Multiple files for SVN
- Separate files for System Components
- No merge conflict since
  - One engineer per component
  - Each component one file
- Result: Just update / commit needed



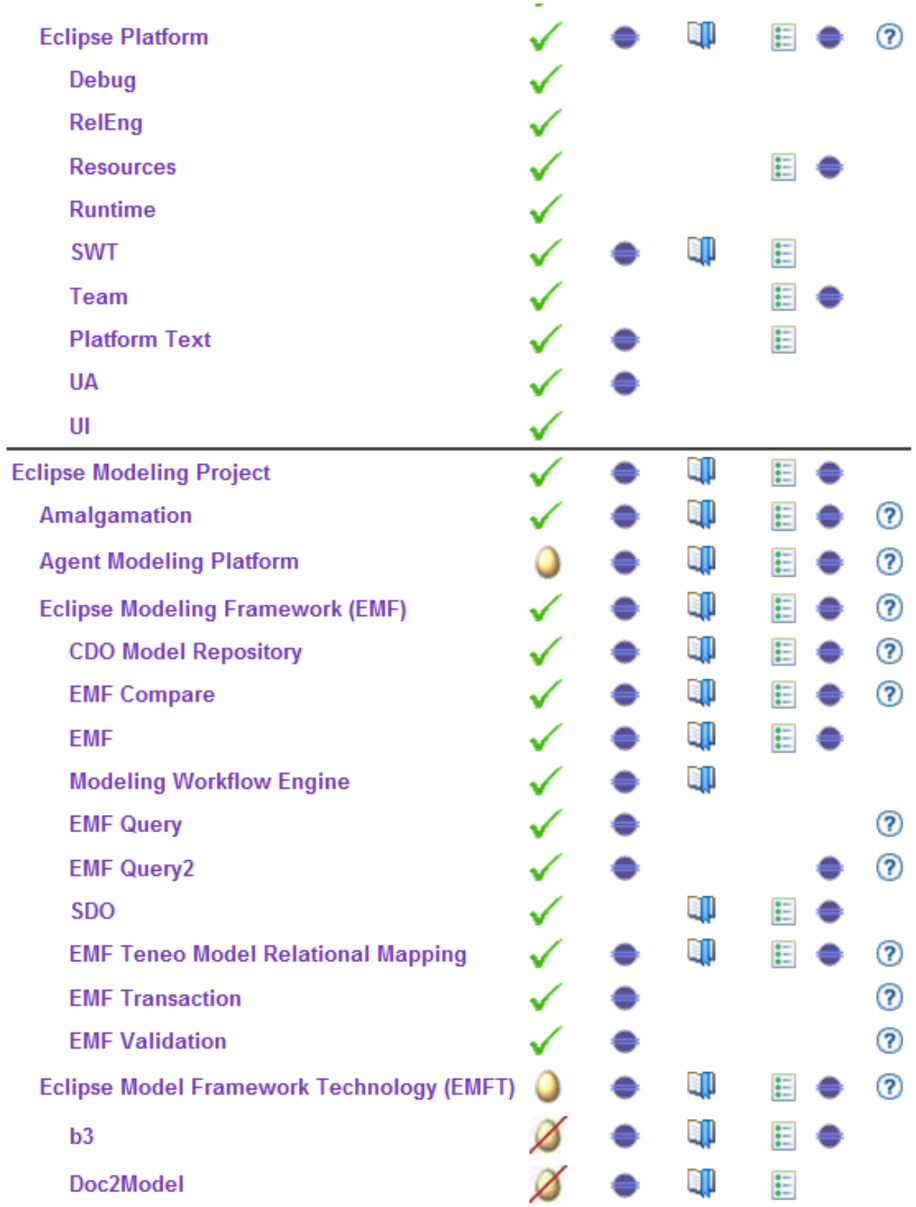
Fourth Step – Storing it Version Controlled

- Using SVN
- Allows for version history
  - What happened yesterday
- Trunk/Tag/Branch
  - Not sufficient for us
- Centralized control needed
  - SVN internal copy as new Head-Revision



Why not Other Alternative Tools?

- What about CDO, Hibernate …?
- So many good eclipse projects
  - But which one to use?
- There is little time for evaluation!
- Question of acceptance…
  - SVN is simple for engineers
  - SVN is simple for development



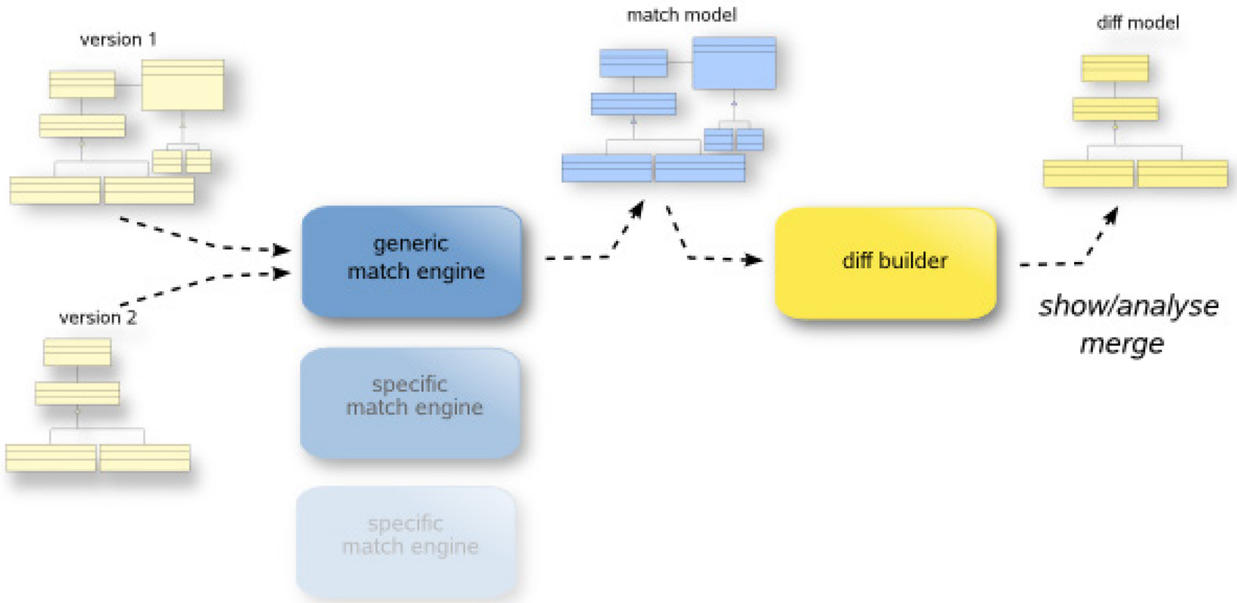
*Source : www.eclipse.org/projects/listofprojects.php **(accessed 31.10.2011)**

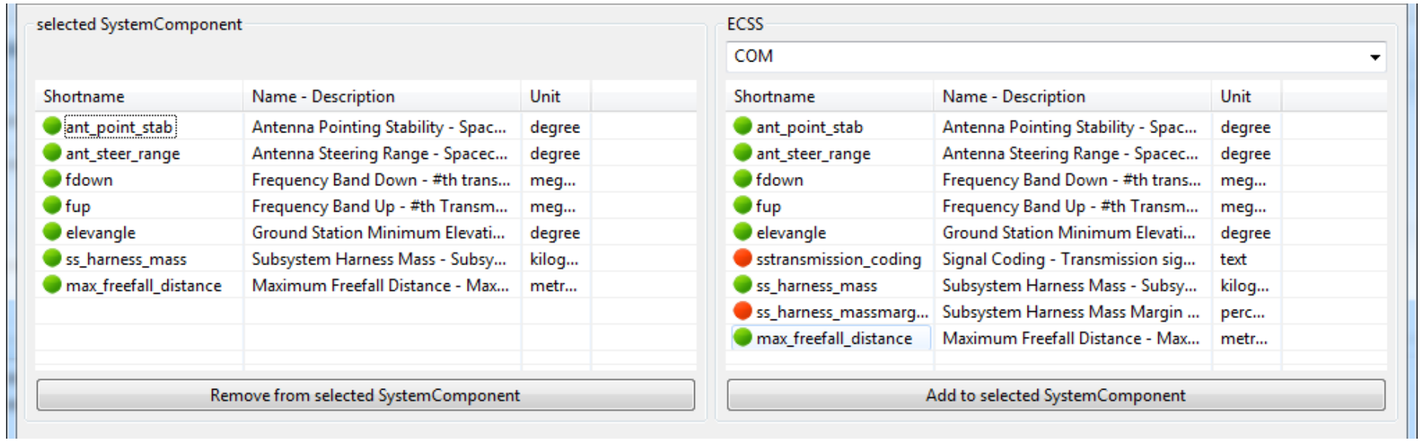
Eclipse the Bad Side…

- Sometimes poor documentation
- Non appropriate examples

- EMF compare framework
  - Simple comparisons needed
  - 2 days of effort – No results

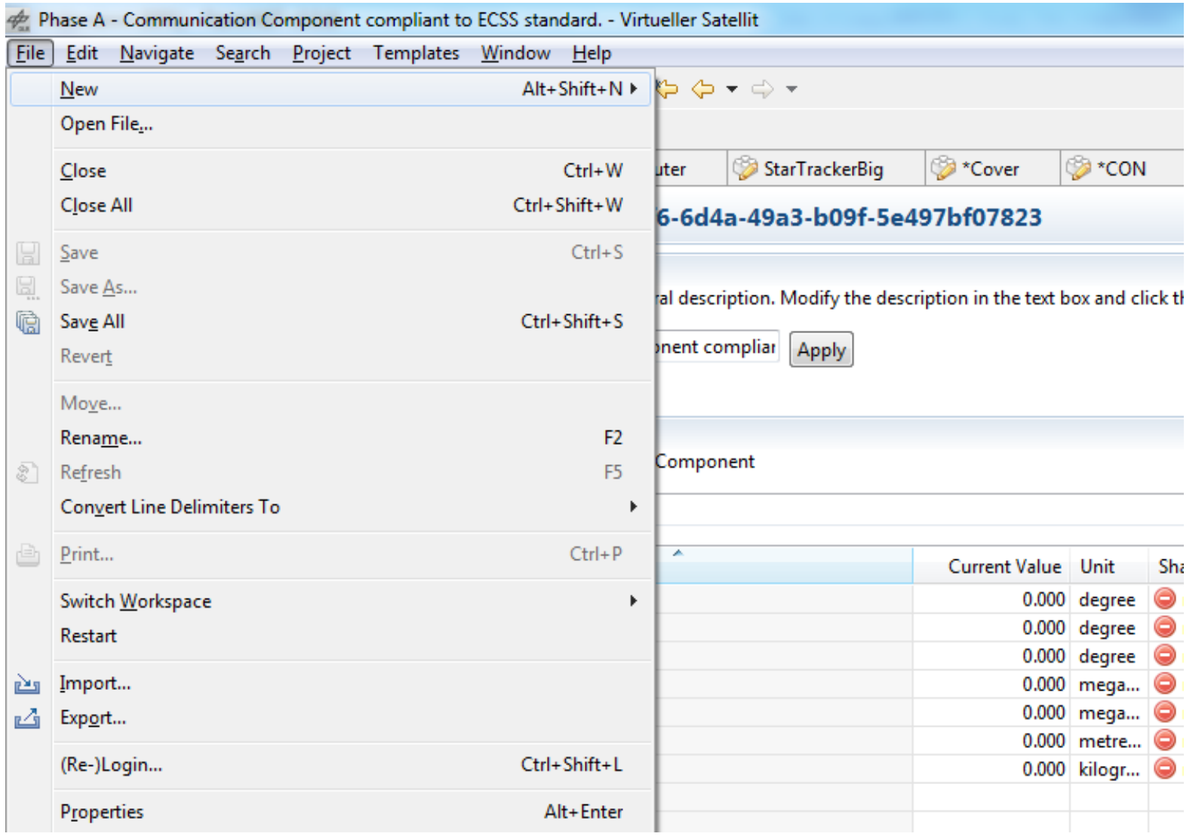
  - Developed our own comparison
  - Not even 1 day of effort !!!





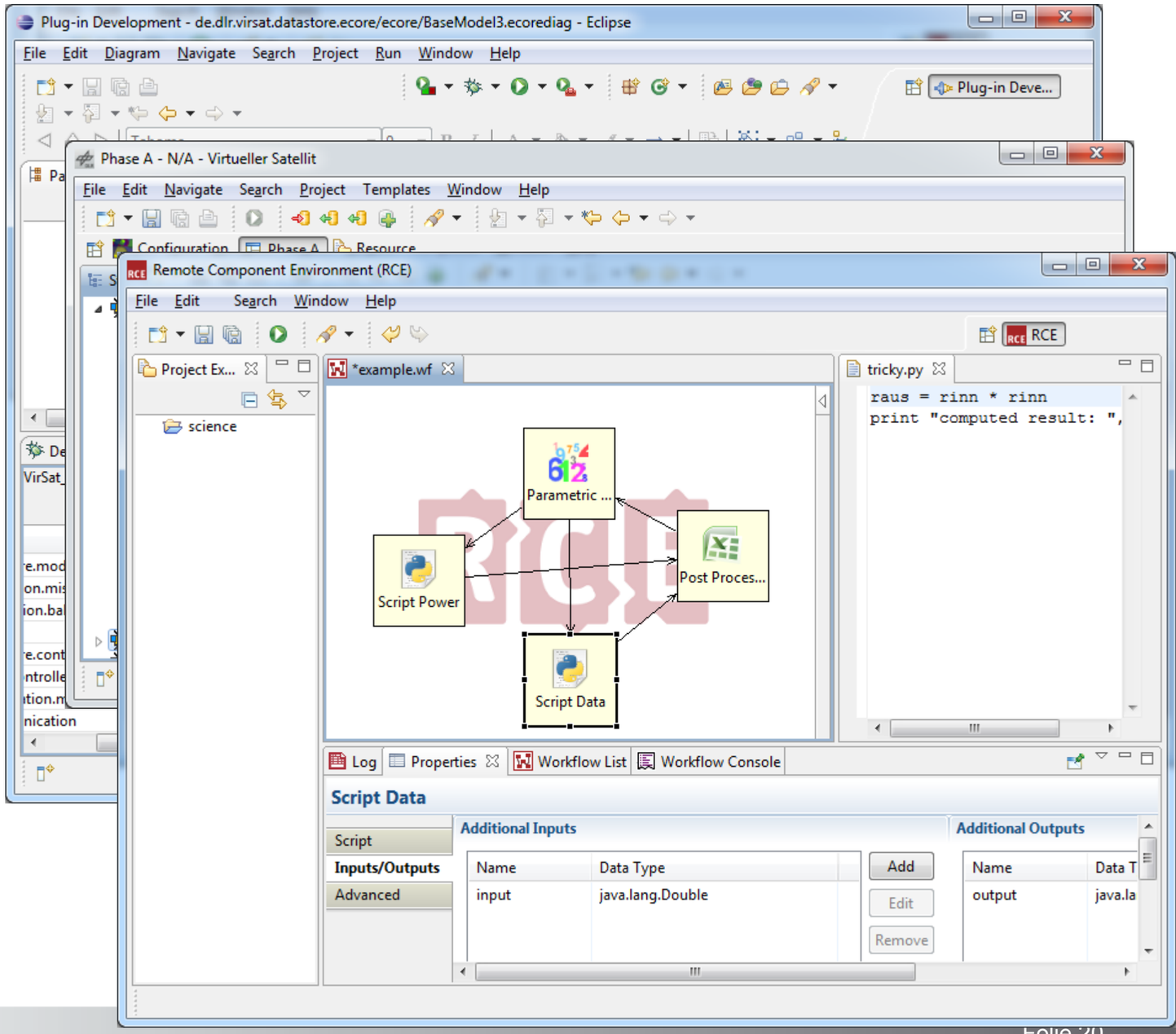
A Docking Maneuver to E4…

- Our current Eclipse version
  - 3.7 Indigo
- Our way to E4
  - Not many trouble expected
  - Changed to Command Framework
- Good experience with Command Framework but…
  - What about Ctrl-S - Still an Action…
  - What about Toggle-Buttons…



Eclipse the Good Side…

- A good tool for SW development…
- Many good tools for applications
  - Modeling Framework
  - Xtext
  - …
- Many other projects
  - Integration on RCP level



Taking software engineering to space?

- Open source software engineering is concurrent…
  - It seems years ahead of the classical engineering disciplines…
- We already use Subversion as data storage backend!
- Why don’t we use…
  - Mantis/Mylyn for traceability in the CEF design sessions?
  - Junit Test Runner for verifying simulation modules?
  - Equinox for component based simulations?

What Have we Seen Today…

- A little story of building a spacecraft. We have seen that a lot of different experts are contributing to such a design.

- An application to design spacecraft and to go beyond the early planning phase. All built on top of Eclipse RCP and EMF.

- Some good and bad aspects on using Eclipse. In particular the broad variety of projects and poor documentation is a main blocker for our developments.

See you soon…

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